

The University of Chicago

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INJECTION OF POTASSIUM CHLORIDE
SOLUTIONS INTO NORMAL
CONSCIOUS DOGS

A DISSERTATION SUBMITTED TO THE
FACULTY OF THE DIVISION OF THE
BIOLOGICAL SCIENCES IN CANDIDACY FOR
THE DEGREE OF DOCTOR OF PHILOSOPHY

DEPARTMENT OF PHYSIOLOGY

1939

By
HARVEY M. SCHAMP

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SOME EFFECTS OF CONSTANT INTRAVENOUS INJECTION OF POTASSIUM CHLORIDE SOLUTIONS INTO NORMAL CONSCIOUS DOGS

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THE MAJORITY of workers are in disagreement as to the nature of the fundamental cause or causes of adrenal insufficiency. The most widely held theory is that the syndrome is due to some defect in salt and water metabolism. Some have suggested that defective sodium metabolism is the primary cause (1, 2, 3); others, that it is a failure of the blood-diluting mechanism (4, 5, 6, but see also 7); and still others, that the syndrome is due to hyperpotassemia (8, 9, 10).

Various workers have induced some of the symptoms of adrenal insufficiency by KCl administration, but the majority of the authors have not examined their animals or experimental subjects on more than a few of the facets of the problem. Zwemer and Truszkowski (11) present the most comprehensive report to date, but their report lacks details of experimental technic and treats only subjectively of the symptoms of adrenal insufficiency. In their experiments, after intraperitoneal injections of KCl solutions, the blood potassium level of otherwise normal cats rose and was maintained at high levels by subsequent injections. Anorexia was present when the serum potassium was 30 mg. %, severe muscular asthenia appeared when the serum potassium was above 40 mg. %, convulsions were obtained at about 50 mg. %, and death occurred at 60 mg. %. In measuring the rate of disappearance of potassium from the blood stream, Whelan (12) injected 10% KCl intravenously into dogs and found an increase in urine sodium like that of adrenal insufficiency. In normal human beings, intravenous injections of KCl solutions produced hemoconcentration, a symptom prominent in Addison's disease (13). Winkler et al. (14) injected isosmotic KCl solutions (intravenously) into normal dogs and obtained electrocardiographic records of some of the phenomena reported in dogs with adrenal insufficiency (15). In acute experiments, Hastings and Compere (8) injected KCl intravenously into dogs and reported that death occurred when the potassium in the serum reached 80 mg. %, a concentration lethal to the mammalian heart in vitro (16) and in vivo (14). Low blood sugar values after injection of potassium salts have been observed (17). Keith and Binger (18) reported the experimental induction of high levels of serum potassium in normal human beings and the presence of equally high potassium levels in diseased conditions without concomitant clinical symptoms of potassium poisoning. Thus it can be seen that each single report is concerned with only a few of the changes due to hyperpotassemia. In the experiments to be described, therefore, an attempt has been made to record quantitative as well as subjective data on as many different aspects of adrenal insufficiency as possible.

It should be noted that most of the reports in the literature are concerned with acute experiments in which the injections of potassium were made during a few minutes or a few hours. In our preliminary experiments an attempt was made to maintain constant intravenous injections of KCl solutions in such amount and concentrations that the individual dogs would live as long as untreated adrenalectomized dogs. It was found that 6 to 8% KCl injected at a rate of 6 cc./hr. was lethal after 2 to 12 days.

The injection of 6 cc./hr. produced a minimum of blood dilution. Despite the fact that the injected material has an osmotic strength 4 to 6 times as great as that of blood, no hemoglobinuria was observed at any time.

METHODS

A dog was lightly anesthetized with pentobarbital sodium (Nembutal), 32 mg./kg., and a small longitudinal incision was made in the neck near the jugular vein, rigid asepsis being observed. A white rubber tube of standard make (3/16 in. diameter with 1/16 in. bore)¹ was put into the jugular vein proximal to a tight ligature and was pushed cardial for 6 or 8 inches. This tube, serving as an elongate cannula, was tied in place by two tight ligatures around the vein wall, leaving 5 or 6 inches of tube outside the vein. A piece of ordinary tire-patching was cemented on the tube about 3 inches from the external end. A needle was threaded, using a foot or so of linen thread which was tied to the end of the tube. This needle was pushed through the subcutaneous spaces and out through the skin about an inch caudad to the incision. Thus, when the thread was pulled, the tube followed it to a subcutaneous position near the middle of the back of the neck. The incision near the jugular vein was closed, and the dog was bandaged and allowed to recover.

On the third postoperative day, the bandage and stitches were removed. After local anesthesia had been induced in the skin at the back of the neck, the thread was pulled until the tube was brought out of the dog's body to the point at which the tire-patching was directly beneath the skin. In this position, the tire-patching prevented the tube from pulling out of the animal. Another piece of tire-patching was cemented to the tube outside of the skin to prevent the tube from slipping back beneath the surface. Through this tube, intravascular injections of any amount of fluid could be made at any desired rate. Blood samples could be withdrawn through the tube rapidly and efficiently. When a sample was to be drawn, about 1 cc. of Ringer's solution was injected through the tube and then 1 cc. or more of blood slowly withdrawn before the sample was collected. The whole process of injection and sample collection was painless, simple and convenient.

The tube was held in one position on the dog's neck by a heavy leather collar. By means of a constant injection pump, fluids were injected into a system of rubber tubes which led into the intravenous tube. The rate of injection could be varied from 1 to 40 cc. per hour. In all the experiments here described, a rate of about 6 cc./hr. was used, thus preventing undue blood dilution. The dogs were kept in metabolism cages. A chain from the side of the cage to the dog's collar allowed free but not excessive movement.

Determinations were made of the serum and urine content: (a) of potassium, by the microphotoelectric method of Hoffman (19); (b) of sodium, by the method of Hoffman and Osgood (20); (c) of chloride, by the method of Patterson (21); (d) of urea, by the method of Van Slyke (22) and (e) of glucose, by the method of Miller and Van Slyke (23). Rectal temperatures were recorded in some instances, and hematocrit determinations were made by centrifuging citrated or heparinized blood in capillary tubes.

RESULTS

The data on 6 dogs are presented in tables 1 through 6. The urine volumes reported below are those collected as the dog voided them. Each sample was analyzed as a unit.

¹ Manufactured by Salisbury Rubber Company.

TABLE 1. PROTOCOL ON dog 1, INJECTED WITH 6% KCl AT A RATE OF 6 CC./HOUR

Hr. Inj.	Hemato- crit	Serum			Urine							
		K ⁺	Na ⁺	Cl ⁻	Vol.	Per hr.	K ⁺	K ⁺	Na ⁺	Na ⁺	Cl ⁻	Cl ⁻
	% cells	mg. %	m. eq./l.	m. eq./l.	cc.	cc.	mg. %	gm.	m. eq./l.	m. eq.	m. eq./l.	m. eq.
0	38.8	17.5	156	102.6								
4½	43.5	13.8	171	85.9								
17½	42.7	19.0	168	103.7								
20½		20.5										
42½	26.1	19.0	165	102.8	250	4.7	2580	6.45	64	16.0	233	58.3
52½	27.8	17.8	168	99.1								
72					200	7.0	3640	7.28	34	6.8	166	33.2
78½	29.9	28.7	168	98.8								
90½		23.8	166	96.4	215	11.3	3450	5.27	12	2.5	406	87.3
101½	29.9		170	102.3								
111½	Found Dead				188	17.9	2260	4.25	11	2.0	526	98.9

The last serum sample from dog 2 was drawn at the very moment of death. The injection pump had been disconnected 5 to 7 minutes before the heart ceased to beat, so blood from the auricle (for autopsy showed this to be the location of the end of the tube) was a well mixed sample.

None of the gross symptoms of adrenal insufficiency was seen. At no time did the animals exhibit the asthenia reported in cats (11) and in dogs (8). It should be emphasized that the dogs were visited at least once each 5 hours so that there could have been no severe or prolonged collapse or asthenia without its having been noticed and recorded. The interesting dog in this connection was dog 2. This dog remained in good spirits until after urine sample 8 was collected. A severe lassitude, but no weakness, appeared during the following 2 hours. The tube was disconnected from the injection pump and several minutes passed before the last blood sample was drawn. And in the next 5 minutes the dog collapsed and died. The reactions of the dogs to the manipulations necessary to obtain rectal temperatures were normal. Although they did become accustomed to the handling, muscular tension was always present and the dogs promptly jumped to their feet when the thermometer was withdrawn. There was no sign of the convulsions described by Zwemer and Truszkowski (11).

The dogs were offered a large bowl of cooked beef lung and bread at the same time each day, and in no case, except within a few hours of death did the food go untouched. The daily food consumption toward the end of the experiment was the same as during the control period, and the daily ration was more than enough to maintain body weight. In contrast to the findings of Zwemer and Truszkowski (11) in cats, these dogs had no indication of anorexia. Although no quantitative tests were

TABLE 2. PROTOCOL ON dog 2, INJECTED WITH 8% KCl AT A RATE OF 6 CC./HOUR

Hr. Inj.	Serum			Urine				
	K ⁺	Na ⁺	Urea N	Vol.	Per hr.	Na ⁺	Na ⁺	Urea N
	mg. %	m. eq./l.	mg. %	cc.	cc.	m. eq./l.	m. eq.	mg. %
0	17.5	161	19.5	295	6.1	77	22.7	749
2				55	27.5	40	2.2	874
6	31.2	154	14.6	85	21.2	177	15.0	297
12½	24.1	148	12.2	100	14.3	72	7.2	228
18½	30.6	175		45	7.5	43	1.9	689
33½				143	9.5	65	9.3	802
40½	32.6	156		100	14.3	73	7.3	925
43½				78	26.0	80	6.2	955
45	58.1	150	27.5	45	22.5	90	4.1	817
46	Died							

TABLE 3. PROTOCOL ON dog 3, INJECTED WITH 6% KCl AT A RATE OF 6 CC./HOUR

Hr. Inj.	Serum		Urine					
	K ⁺	Na ⁺	Vol.	Per hr.	K ⁺	K ⁺	Na ⁺	Na ⁺
	mg. %	m.eq./l.	cc.	cc.	mg. %	gm.	m.eq./l.	m.eq.
0	17.8	166	185	7.7	250	0.46	13	2.4
8	15.5	153	55	9.2	760	0.7	94	8.7
21 $\frac{1}{4}$	19.0	150	300	23.0	440	1.3	141	42.3
33 $\frac{1}{4}$	27.5	152						
81	20.1	160	380	6.3	1700	6.46	93	35.3
105	25.3	186						
119 $\frac{1}{4}$	24.0	176	230	6.0	1560	3.58	75	17.3
142 $\frac{1}{4}$	20.0	148	280	11.3	3800	10.64	59	15.3
154 $\frac{1}{4}$	30.0	140	185	15.4	1850	3.32	29	5.4
165	21.2	132	46	4.2	3110	1.43	19	0.9
175	34.8	134	217	21.7	4040	8.77	46	10.0
190 $\frac{1}{4}$	50.5	142	243	16.2	2090	5.08	67	16.3
217 $\frac{1}{4}$	42.0	148	690	25.5	1090	7.49	65	44.8
238			375	17.9	2750	10.3	25	9.4
266	39.3	152	375	13.4	3725	13.97	33	12.4
269 $\frac{1}{4}$	Found Dead							

performed, as far as one could see, the dogs were perfectly normal with regard to appetite, posture, and general behavior.

DISCUSSION

The theory that the symptoms of adrenal insufficiency are due to potassium poisoning is not upheld by the data. Objectively, the only symptom indicated by the

TABLE 4. PROTOCOL ON dog 4, INJECTED WITH 6% KCl AT A RATE OF 6 CC./HOUR

Hr. Inj.	Rectal temp.	Serum				Urine					
		K ⁺	Na ⁺	Cl ⁺	Urea N	Vol.	Per hr.	K ⁺	Na ⁺	Cl ⁻	Urea N
	°C.	mg. %	m.eq./l.	m.eq./l.	mg. %	cc.	cc.	mg. %	meq./l.	meq./l.	mg. %
0		9.2	162	91.0	18.8						
0	40.0					235	14.2	460	22	42.6	124
12	40.5	23.0	174	91.5	27.5	230	11.3	1930	154	80	865
16 $\frac{1}{2}$	40.3					230	51.1	3480	140	244	820
20 $\frac{1}{2}$	39.8										
24	40.2	20.8	161	93.0	26.9						
33 $\frac{3}{4}$	40.0					280	16.4	4600	60	396	859
37 $\frac{1}{2}$	40.0	33.6	170	93.1	22.1	83	20.8	2625	61	384	598
48	40.0	22.5	158	95.4	24.0	70	6.6	5400	57	378	688
57 $\frac{1}{2}$						66	6.9	4745	82	416	1107
60		20.0									
65 $\frac{1}{2}$	39.0					120	15.0	2315	91	455	765
71 $\frac{1}{2}$	39.3	21.1	156	104.0	28.8	165	26.0	2170	84	426	434
81 $\frac{1}{2}$						110	11.0	6080	89	369	1039
84		24.9	169	109.0	23.4						
94 $\frac{1}{2}$	39.6					150	11.5	2800	43	345	623
96	39.0	11.2	156	103.0	27.7						
106 $\frac{1}{2}$	39.5					130	10.8	3380	43	165	763
108 $\frac{1}{2}$	39.6	28.2	190	123.0	23.7	110	55.0	4800	70	400	651
117						70	8.2	4200	40	275	778
120	40.0	16.3	154	107.0	29.2						
131 $\frac{1}{2}$	39.5	34.3	174	121.0	21.2						
135						205	11.3	5220	71	330	1400
144		28.0	180	115.0	21.0	125	14.0	3600	100	410	739
156	Found Dead					110	9.2	5350	191	390	1300

data is a high urine sodium. The serum sodium was not consistently altered. The sodium level in the serum of *dog 1* was above the normal level during most of the period of injection, that of *dog 3* was below the normal level; and those of *dog 2, 4, 5* and *6* varied, being sometimes above and sometimes below the normal value. These data do not confirm the contention of Blum et al. (24) that serum sodium falls after the administration of potassium, but are in accord with the work of Whelan (12) who found that intravenous injections of KCl reduced the serum sodium of only one dog in six. The high urine sodium following administration of potassium salts confirms the work of many authors (12, 25). The data show that although there were rises in urine sodium concentrations and in sodium excretion rates (milli-equivalents per hour) dur-

TABLE 5. PROTOCOL ON *dog 5*, INJECTED WITH 6% KCl AT A RATE OF 6 CC./HOUR

Hr. Inj.	Rectal temp.	Hemato- crit	Serum					Urine						Ate food
			K ⁺	Na ⁺	Cl ⁻	Urea N	Glucose	Vol.	Per hr.	K ⁺	Na ⁺	Cl ⁻	Urea N	
	°C.	% cells	mg.%	m.eq./l.	m.eq./l.	mg.%	mg.%	cc. 160 230	cc. 11.0 21.0	mg.% 100 35	m.eq./l. 101 83	m.eq./l. 91 122	mg.% 1318 934	
0	39.0													
0	39.3													
0		37.6	15.0	135	103.1		84							*
0	39.2	39.8	14.3	140	94.9	17.4	82							
0	40.0	38.7	14.6	134	102.7	23.8	71	260	20.8	40	65	116	470	
0	39.0	38.9	15.0	140	97.3	22.3	92	250	17.9	17	62	93	847	*
0	39.1	35.9	14.3	138		10.2	91							
0	38.9	40.5	10.7	136	101.4	27.8	101							
12½	40.9	37.9	19.3	139	77.9		83	185	8.2	980	122	399	1130	*
20½	40.9							80	10.0	850	113	364	305	
22½	40.9							40	20.0	400	37	208	197	
24½	41.0	35.3	14.4	129	91.6	13.5	97							
35½	40.1	33.2	17.0	135	94.7	11.1	69	125	9.7	1035	56	940	573	*
43	40.9							115	15.2	1375	15	1035	372	
48		34.5	15.9	129	93.1	11.9	85							
54½	40.5							105	9.0	1520	17	795	1048	
60½		25.5	16.9	131	93.0	8.2	91							
62½	40.1							225	29.0	51	2	437	23	*
70½	41.0							110	13.6	1405	42	119	390	
72½		32.3	25.8	143	111.7	12.6	82							
81½		31.8	15.2	143		12.6	109							
86½								120	7.5	1500	35	595	1290	
92½	40.0	35.2	19.7	147	100.6	15.6	55							
98	40.4							157	12.6	1335	34	610	1185	
101½	40.9	33.5	18.9	132	90.7	11.8	45							
103½								100	18.2	1250	32	800	709	
111½		38.0	33.1	119	93.3	22.5	86							
114	37.9							50	4.8	1700	9	405	760	
117								38	12.2	1480	8	292	940	
121½	36.4	30.6	39.0	145	98.2	32.4	137							
127½								110	10.0	1550	12	367	725	
131	37.0	26.7	38.8	147	104.5	40.1	143							
135½		Died						40	4.5	355	17	182	245	

ing the early hours of injection, both these values later decreased to the normal range or below. The animals continued to eat their daily rations of cooked beef lung and bread, so that the incoming sodium was normal in amount. Thus, although there was a tendency toward a negative sodium balance like that observed in adrenal insufficiency, the animal itself corrected the condition before any of the symptoms of sodium deficiency appeared. The dogs did not show the asthenia described in human sodium depletion (3).

The serum sodium values ran somewhat higher than those reported by most workers (26, 27), although they are in the range reported by Whelan (12). We are at a loss to account for these high values as: the same range of values were obtained in completely normal dogs, so evidently the technic itself was not responsible; nor could any sodium be found in the mineral oil under which the blood was collected; nor does it appear to be the chemical method, for rat serum, using this method, gave values of about 145 milli-equivalents per liter which level is normal for this species. It is clear, at any rate, that no consistent drop in the sodium concentration in the

serum, as we were measuring it, occurred. It was observed that there was no consistent relationship between serum sodium and potassium changes.

It can be seen that it was very difficult to increase the serum potassium by a very great margin. Even the injection of KCl in such amounts as were lethal in 48 hours failed to maintain the serum potassium much above 30 mg. % until near death.

In 1883, Bochefontaine (28) found that the injection of 2 gm. of potassium salts would kill a dog. A more recent study (14) showed that the injection of 10 cc. of 1.12% KCl solution per minute would kill their dogs in about 50 minutes. With the constant injection pump employed in our experiments, a much larger amount of potassium had to be injected before the animals succumbed. The data on *dog 3* shows that about 400 mg. KCl were injected each hour. Since the dog survived 265 hours of injection, this would make the lethal amount of KCl 90 gm. The difference between our results and those of previous workers probably can be explained on the basis of rate of injection. At the moderately slow rate of injection used the animals excreted enough

TABLE 6. PROTOCOL ON *dog 6*, INJECTED WITH 6% KCl AT A RATE OF 6 CC./HOUR

Hr. Inj.	Rectal temp.	Hemato- crit	Serum					Urine					Ate food	
			K ⁺	Na ⁺	Cl ⁻	Urea N	Glu- cose	Vol.	Per hr.	K ⁺	Na ⁺	Cl ⁻		Urea N
	°C.	% cells	mg. %	m.eq./l.	m.eq./l.	mg. %	mg. %	cc.	cc.	mg. %	m.eq./l.	m.eq./l.	mg. %	
0		38.8	13.6	162	95.3	25.9								*
0		36.8	13.8	153	85.6	26.0								
0	39.6	34.6	10.8	164	81.8	26.2	96							
0	40.1	33.4	12.2	163	91.8	26.2	79	135	9.0	16	3	18.7	1600	
0	40.3							110	24.4	117	3	4.0	2354	*
0	40.1	31.3	11.0	162	92.7	26.4	91	135	19.4	36	1	19.5	1468	
12	40.0	33.1	15.1	162	94.1	13.9	67							
15½								85	5.5	480	8	180.8	1440	
21½	40.9							200	33.3	635	9	102.2	296	
23½		33.7	17.3	163	91.7	12.3	72							
34	40.2							150	12.5	920	9	304.7	1419	*
36½		34.2	15.5	145	91.1	18.8	69							
48	40.2	37.2	19.0	137	91.1	19.3	85							
54		Died						170	8.5	805	6	360.5	1236	

potassium to survive much longer periods. Undoubtedly much smaller amounts would have killed the dogs had the injections been made suddenly. As an example of the importance of the rate of injection, Winkler et al. (14) report a dog which survived 4.29 gm. of KCl (in isosmotic solution) injected in 54 minutes, but which succumbed at a later date to a much smaller amount, 0.89 gm. (as 9% KCl) when the injection was made in 3 minutes.

The hematocrit values as reported in the tables obviously indicate no hemoconcentration, on the contrary, a slight dilution is evident. This result fails to confirm the work of Levy (13) on normal human beings after potassium injections.

The values for serum glucose show fairly large, but not unusual variations. As can be seen from the tables, the serum glucose rose following the consumption of meals all of which contained bread. Most significant is the fact that at no time did the blood sugar reach dangerous or convulsive levels (25–35 mg. %).

There was no great impairment of the ability of the kidneys to concentrate urea, nor did the excretory rate vary significantly from the normal. Despite the great load of potassium thrust upon the kidneys, the serum urea levels remained reasonably constant. This may be taken as definite evidence that the kidneys were not injured by the potassium.

An attempt has been made to correlate urine volume with the other data collected, but no definite relations could be found. From the data on *dog 2*, it appeared as if the urine volume could be correlated with sodium concentration in the urine, but the records of the other dogs showed that no such correlation could be made. Not even by

plotting the observed urine volumes as percentages of the normal could the urine volume, as recorded, be related to the serum or urine content of potassium, sodium, chloride, or urea. The data certainly do not indicate anuria with high serum potassium (29) nor was there a marked diuresis (12, 30). The small increase in urine volume was of the same order of magnitude as that found in man by Keith and Binger (18) after oral administration of KCl.

The analyses for serum and urine chloride led to no definite conclusions. The urinary chloride accounted for less than one-half of the urinary potassium, thus leading to the assumption that much of the base in the urine was balanced by other anions, probably by bicarbonate. *Dog 4*, for instance, excreted about 1600 m.eq. of potassium and only about 750 m.eq. of chloride during the period of observation. These data not only fail to account for the anion accompanying the urinary base, but fail to account for one-quarter of the thousand or so milli-equivalents of chloride that were injected. The 250 m.eq. of chloride injected but not recovered in the urine might have: (a) remained in the blood stream, although the data do not indicate this; or (b) been excreted by way of the feces, although Harrop (25) thinks this unlikely; or (c) been stored in the tissue cells, but Bourdillon (31) and Hastings and Eichelberger (27) have reported data that render this unlikely. More complete analyses might have shown the location of the last one-fourth of the injected chloride.

Our work lends no support to any existing theory of adrenal insufficiency, but it does throw serious doubt on the theory that potassium poisoning is the responsible factor. In confirmation of this, several instances of crisis, shock, or collapse with normal or low potassium levels in the serum, both in experimental animals with adrenal insufficiency and in Addison's disease, were mentioned in the discussions at Cold Spring Harbor. Without directly confirming any theory, our work indicates that the rôle of potassium in adrenal insufficiency is probably a secondary one, perhaps like that suggested by Britton, Silvette and Kline (26). These authors propose a theory that regards the elevated serum potassium as secondary to a change in permeability of tissue cells (as a source of the potassium), concomitant with changed renal function (accounting for the prevention of potassium loss). They ascribe all the symptoms of adrenal insufficiency to the fundamental change in membrane permeability, while our work merely indicates that the symptoms cannot be considered to be the result of the elevated serum potassium.

Now let us consider the results presented in this paper in the light of those reported by Richter and Eckert (32), Rubin and Krick (33), and Sandberg, Perla and Holly (34). Richter and Eckert found that the adrenalectomized rats, given their choice of solutions of several salts of sodium, KCl and distilled water, 'chose' to drink more KCl solution than did normal rats. That these rats chose well is shown by the fact that their choice maintained their lives. It would appear that the salt hunger of adrenal insufficiency extends not only to NaCl and Na lactate, but also to KCl in measurable amounts. Rubin and Krick showed that normal rats, eating only as much as adrenalectomized rats, had negative balances of sodium, potassium and chloride, which facts are the basis of their explanation of the high serum potassium as a secondary phenomenon. Sandberg, Perla, and Holly demonstrated that, of the food they ate, adrenalectomized rats retained less potassium than did normals. In other words, the excretion of exogenous potassium is no problem to the adrenalectomized rat. The 'hunger' of adrenalectomized rats for potassium salts, the explanation of their negative salt balance by comparison with normal rats, and our inability to produce the significant symptoms of adrenal insufficiency in dogs by injection of potassium salt, minimize the importance of the rôle of potassium as a primary factor in adrenal insufficiency.

SUMMARY

A technic for constant intravenous injections into normal conscious dogs is briefly described. Solutions of KCl were injected by this technic into 6 dogs, leading eventually to their deaths in from 2 to 12 days. Determinations of blood concentration (hematocrit), body temperature, and serum and urine content of potassium, sodium, chloride, glucose and urea nitrogen were made at intervals throughout the period of the experiment. The dogs showed only one of the symptoms of adrenal insufficiency, namely, an increase in urine sodium. But this change cannot be regarded as of much significance as it was only temporary. No anorexia, asthenia, or convulsions were observed in any of the animals. From these data, it seems doubtful that potassium poisoning is the primary cause of the symptoms of adrenal insufficiency in the dog.

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